DSN Telemetry System, 1973–1976

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This article provides a definition, functional description, and block diagram of the DSN Telemetry System. The characteristics of the capabilities being added during the 1973–1976 period are described. This system will be used to provide multiple-mission support to various flight projects.

I. Introduction

The Deep Space Network Telemetry System is being implemented by means of incremental additions and modifications, to provide multiple-mission support to a variety of planetary and interplanetary flight projects. Specifically, current system configurations are implemented to support:

(1) Pioneers 6 through 9

(2) Pioneers 10 and 11

(3) Mariner Venus/Mercury

(4) Helios A

(5) Viking

II. System Description

The DSN Telemetry System performs three main functions:

(1) Telemetry data acquisition and detection

(2) Telemetry data processing and transmission

(3) Telemetry System validation

Telemetry data acquisition and detection consist of those functions necessary to extract the telemetry information modulated on the downlink radio-frequency carrier(s) from the spacecraft and to detect the data bits. Telemetry data processing and transmission consist of those functions necessary to format, record, and transmit the data to users. Telemetry System validation consists of those functions necessary to validate the performance of the Network and to verify that this performance meets specifications.

III. Key Characteristics

Key characteristics of the DSN Telemetry System evolve as new components and capabilities are added. For this reason, a succession of Telemetry System models is defined, each representing a new increment of capability. The following are key characteristics of the models through the period of 1973—1976.

A. Mark III-73 Model

(1) Multimission capability at each DSS for receiving and formatting uncoded telemetry and block-coded telemetry

(2) Mission-peculiar software for Pioneer convolutional-coded telemetry

(3) Centralized monitoring of Telemetry System performance by observation of project displays in the Mission Control and Computing Center (MCCC)

(4) Capability at each DSS for single carrier, dual subcarrier, and formatting for high-speed and wideband communication

(5) Recording of pre- and post-detection analog records with nonreal-time playback

(6) Production of digital Original Data Record (ODR) at each DSS, and playback via manual control or automatic response to project inputs

(7) Real-time reporting of telemetry status at the station to the DSS Monitor and Control Subsystem

B. Mark III-74 Model

Key characteristics of the Mark III-74 model are the same as those for Mark III-73, plus the following:

(1) Multimission capability for sequential decoding of convolutionally coded telemetry data (to accommodate both Pioneer and Helios coded data)

(2) Real-time monitoring of Telemetry System performance at the Network Operations Control Center (NOCC)

C. Mark III-75 Model

Key characteristics of the Mark III-75 are the same as those for Mark III-74, plus the following:

(1) Capability at the 64-m DSS to handle multiple carriers (up to four) and multiple subcarriers (up to six) with decoding, ODR, and formatting for communications circuits

(2) Centralized monitoring of Telemetry System performance at the NOCC, and reporting via the DSN Monitor and Control System

(3) Central log (Network Data Log) of all data received at the DSS, with gap accounting and automated recall of missing data from the DSS ODRs

(4) Generation of the Intermediate Data Record (IDR), a time-merged record of all received telemetry data

(5) Generation of Telemetry System predicts and configurations, and transmission to DSS for manual control of system elements

IV. Functional Description

A brief description of the operation of the DSN Telemetry System is presented in the remainder of this section. A simplified block diagram of the system is shown in Fig. 1.

At the Deep Space Station, spacecraft radio signals are received and amplified in the Antenna Microwave Subsystem. The RF carriers are then acquired and tracked by the receivers. A coherent reference and the sideband signals are passed to the Subcarrier Demodulator Assemblies (SDA) where the subcarriers are regenerated, separated, and demodulated. Low-rate uncoded data are passed through analog-to-digital (A-D) converters to the Telemetry and Command Processor (TCP) for bit synchronization detection, and formatting for high-speed data transmission. All medium and high-rate streams are passed to a Symbol Synchronizer Assembly (SSA). Coded symbol streams are then forwarded to either a Block Decoder Assembly (BDA) or to a Digital Decoder Assembly (DDA) for decoding. Resulting data streams are outputted to high-speed data (HSD) or wideband (WBD) lines, depending upon data rate. Interlaced with these data are time tags and partial status.

Analog records of all receiver and SDA outputs are made at the DSS by the Pre/Post Detection Recording Subsystem; digital ODRs are made of all data after the bit synchronization and decoding processes.

The high-speed or wideband data are then transmitted to the MCCC or to a Remote Project interface at JPL, and to the Network Operations Control Center. All data inputs to the MCCC and Remote Project Interface are recorded on the Network Data Log. In the NOCC, the telemetry data are processed to analyze DSN Telemetry System performance. The performance is compared to expected values, and status and alarms are relayed to the Network Operations Control Area (NOCA). In addition, a permanent System Performance Record (SPR) is made of the DSN performance and a gap list of all missing or error data is prepared. In the Mark III-75 model, this gap list is used to recall missing data from the DSS ODRs. In the Mark III-73 and 74 models, the recall requests come from the MCCC or are manually inputted at the DSS.

In the Mark III-75 model, the Network Data Log and data recalled from the ODR can be combined in time sequence so that selected data blocks and their time intervals can be placed on an Intermediate Data Record. This record, which can contain data up to a full DSS pass, will be available to projects for their Master Data Record (MDR) processing.

In the Mark III-75 model, Telemetry System predicted signal levels are generated in the NOCC and transmitted to the DSS to be displayed as an aid in the manual control and configuration of the station. These predictions require project inputs concerning spacecraft configuration and data mode.

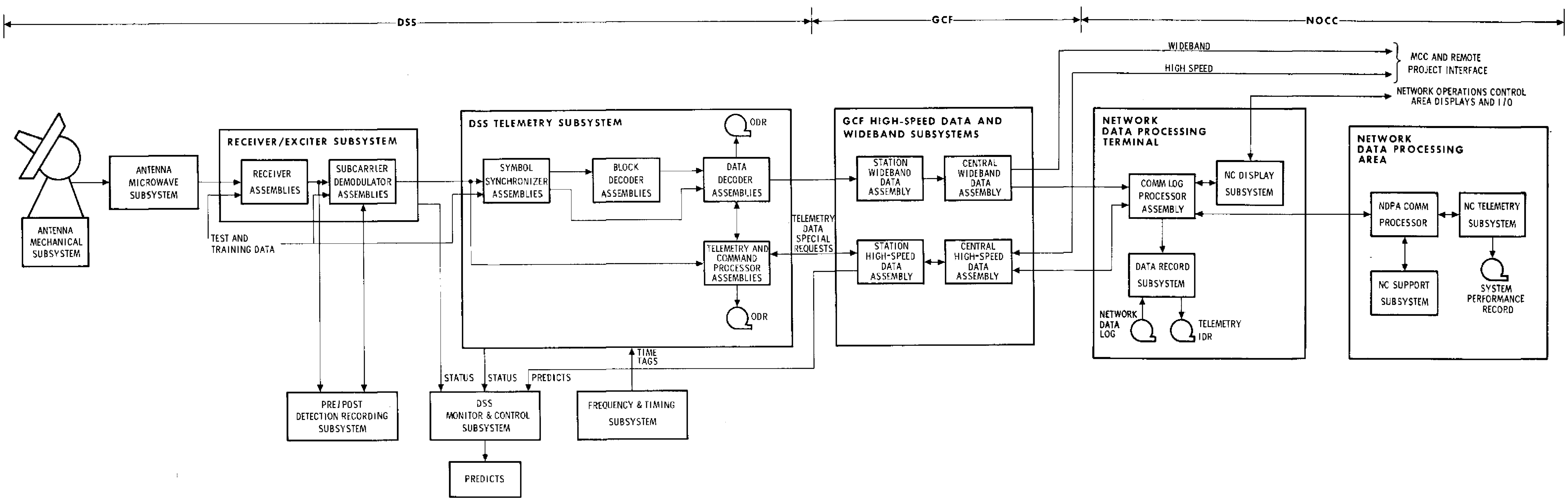

Fig. 1. DSN Telemetry System Mark III-75 block diagram